



## WHAT'S IN THE STARS?

### DESCRIPTION

This lesson guide integrates a series of activities designed to look at stellar evolution and composition.

### OBJECTIVES

Students will

- Discuss the basic steps of stellar evolution and contrast them with Navajo creation stories
- Discriminate between samples representing elemental abundances in the solar system
- Discuss the fusion process in a star

### NASA SUMMER OF INNOVATION UNIT

*Earth and Space Science—Universe*

### GRADE LEVELS

7 – 9

### CONNECTION TO CURRICULUM

*Science and Mathematics*

### TEACHER PREPARATION TIME

2.5 hours

### LESSON TIME NEEDED

3 hours

*Complexity: Moderate*

## NATIONAL STANDARDS

### National Science Education Standards (NSTA)

*Science as Inquiry*

- Skills necessary to become independent inquirers about the natural world
- An appreciation of “how we know” what we know in science

*Physical Science*

- Interactions of energy and matter
- Transfer of energy
- Structure and properties of matter

*History and Nature of Science*

- Science as a human endeavor

### Common Core State Standards for Mathematics (NCTM)

*Statistics and probability*

- Use random sampling to draw inferences about a population

## MANAGEMENT

In preparation for the What's Out There activity, make sure to rinse bottles after they have been sealed to remove any food residues reducing the risk of food allergies. There is an expanded explanation of What's Out There in the Elements and You Guide. It is highly recommended that you laminate the cards for the Cycles in the cards activity to extend their lifespan.

## CONTENT RESEARCH

All stars begin with the fusion of hydrogen into helium. After hydrogen in the core is exhausted, helium and heavier elements fuse in a sequence leading to heavier core elements until iron is generated. Iron requires more energy to fuse than is released and therefore stops the natural fusion sequence.

### Key Terms

- **Element**—Material made of a single type of atom
- **Fusion**—Combination of light nuclei into heavier nuclei
- **Nebula**—Huge cloud of gas and dust

## LESSON ACTIVITIES

The suggested sequence introduces students to stellar evolution then progresses to stellar and universe composition.

### Cycles in the Cards

Students explore stellar evolution and draw parallels to Navajo creation stories.

[http://astrobiology.nasa.gov/index.php?s=file\\_download&id=55](http://astrobiology.nasa.gov/index.php?s=file_download&id=55)

### Elements and You

Students investigate elemental abundances in the universe using random sampling.

<http://bigexplosions.gsfc.nasa.gov/documents/activities/ElementsAndYou.pdf>

### What's Out There

Students look at dry food mixtures in sealed bottles to compare elemental abundances in stars and other celestial bodies.

<http://imagine.gsfc.nasa.gov/docs/teachers/elements/imagine/activities.html>

## RELATED RESOURCES

The Grandma's Apple Pie activity from Imagine the Universe Web site has students select an element existing in an apple pie and trace it back to its origins.

[http://imagine.gsfc.nasa.gov/docs/teachers/elements/imagine/grandma/apple\\_pie.html](http://imagine.gsfc.nasa.gov/docs/teachers/elements/imagine/grandma/apple_pie.html)

## DISCUSSION QUESTIONS

Each activity includes questions for discussion.

Additional questions:

- How do we determine the elemental composition of the Sun? *Using light emission spectra.*
- Why does NASA care what elements are in space? *Elemental composition tells us about our past and may allow for mining resources.*

## ASSESSMENT ACTIVITIES

Each activity has a series of questions in the student pages.

Pretest/posttest questions:

- What is the most abundant element in the Sun? *Hydrogen*
- What is the most abundant element in the universe? *Hydrogen*
- What process fuels a star? *Nuclear Fusion*

## MATERIALS

- Gloves or wet wipes for safe food handling
- Large bowl to mix beads
- Multicolored pony beads or beads of the same size and weight (at least 10 colors)
- Small scoops or Dixie cups
- Uncooked white and brown rice
- Dry split peas
- Dry black beans
- Dry white beans
- Dry pinto beans
- Dry red beans
- Dry red lentils
- Dry brown lentils
- 8-oz clear bottles with lids

**ENRICHMENT**

- Go through the fusion demonstration from the Elements and You guide.
- Have students research the origins of elements in the periodic table.